

# THE MINERAL INDUSTRY OF THAILAND

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Thailand, which is located north of the Andaman Sea and the Gulf of Thailand, east of Burma, west of Cambodia and Laos, and north of Malaysia in Southeast Asia, was a middle-income developing country. Its land area is about 511,800 square kilometers (km<sup>2</sup>). In 2003, Thailand's per capita gross domestic product (GDP) based on purchasing power parity was estimated to be \$7,070 (International Monetary Fund, 2004<sup>§</sup>). The country had a population of about 63.4 million.

In 2003, Thailand's identified mineral resources were antimony, ball clay, barite, bentonite, copper, diatomite, dolomite, feldspar, fluorite, gold, gypsum, iron ore, kaolin, lead, limestone, manganese, marl, phosphate, potash, quartz, rock salt, silica sand, tin, tungsten, and zinc (Department of Mineral Resources, 1998, p. 18). On the basis of quantity of reserves, diatomite, dolomite, gypsum, kaolin, limestone, marl, potash, and silica sand were more abundant than other identified minerals. The resources of barite, copper, fluorite, gold, gypsum, iron ore, lead, quartz, tin, tungsten, and zinc, however, were more important because of their higher economic value. Deposits of identified nonfuel minerals except copper and potash have been developed and produced for domestic consumption and export. Thailand also has small resources of coal, natural gas, and crude petroleum.

Recent exploration by the Government and private companies for nonfuel minerals in Thailand focused mainly on copper, gold, and potash. As a result of exploration during the past 10 years, the Chatree Mine in Pichit Province, which was the country's first medium-scale gold mine to use modern mining and mineral-processing technology, was completed and began operations in late 2001. In 2003, the Udon Thani Potash Project by Asia Pacific Resources Ltd. was waiting for Government approval of the mining leases; the development of the Puthep Copper Project by an Australian company in Loei Province was also waiting for Government approval for a feasibility study. Both projects were expecting Government approval in 2004.

In 2003, Thailand was one of the world's top producers of feldspar and gypsum (Olson, 2004; Potter, 2004). Thailand also was one of the world's leading exporters of cement, feldspar, and gypsum. The mineral production that was important to the Thai economy included barite, coal (lignite), dolomite, feldspar, natural gas, gemstones, gold, gypsum, kaolin, limestone, crude petroleum, rock salt, silica sand, tin, tungsten, and zinc. Some of these minerals were exported to earn foreign currency. The leading export minerals were feldspar, gold, gypsum, tin metal, tantalum powder, and zinc metal. Thailand continued to import such ferrous and nonferrous metals as iron and steel, primary aluminum, refined copper, refined lead, precious metals, and other minor metals to meet its domestic requirements.

According to the National Economic and Social Development Board, the output of the mining and quarrying sector grew by 6.8% in 2003 compared with 10.9% in 2002. The output value of the mining and quarrying sector, which was estimated to be \$1.8 billion in 1988 constant dollars, contributed about 2.2% to the country's GDP in 2003. The continued growth in the mining and quarry sector was the result of increased production of natural gas, crude petroleum, and such industrial minerals as clay, feldspar, fluorspar, gypsum, phosphate rock, silica sand, and quartz stone. The Thai economy, as measured by the GDP, increased by 6.7% in 2003 compared with 5.4% in 2002. The Thai GDP, in 1988 constant dollars, was estimated to be \$83 billion in 2003. The growth in the country's economy was owing to increased output in every major economic sector, especially in the manufacturing sector, which grew by 10.3% in 2003 compared with 6.8% in 2002. The Thai total labor force increased to 34.9 million in 2003 from 34.3 million in 2002, and the rate of unemployment decreased to 2.0% in 2003 from 2.2% in 2002. The inflation rate, as measured by change in the Consumer Price Index, rose to 1.8% from 0.7% in 2002. The country's merchandise trade surplus rose to \$4.2 billion in 2003 from \$2.7 billion in 2002. The total external debt decreased to \$51.8 billion in 2003 from \$59.4 billion in 2002 (Bank of Thailand, 2004b<sup>§</sup>).

## Government Policies and Programs

Thailand's mineral resources are owned by the state. Mineral exploration and development are governed by the Minerals Act of 1967, the Mineral Royalty Act No. 4 of 1966, and the Tin Control Act of 1977. The Minerals Act of 1967, which had been amended in 1973, 1979, and 1991, controls onshore and offshore exploration, mineral production, mineral trading, ore dressing, transport, and export of minerals except petroleum. The Minerals Act of 1967 was amended again in 2002 to bring the Act in line with modern international practices for underground mining that permit mining at depths of greater than 100 meters (m) below the surface without requiring the specific consent of the holder of the surface right.

The Mineral Royalty Act prescribes the rates of royalties to be assessed for different kinds of minerals. The Tin Control Act controls the mining, purchase, sale, and export of tin and contributions of tin to buffer stock. The Environmental Act and the Forestry Act govern environmental protection and management of the mining industry. The Enhancement and Conservation of National Environmental Quality Act controls the issues related to mining. The Forestry Act controls mining in general forest areas.

Under the Minerals Act of 1967, the Ministry of Industry was appointed the principal Government agency to regulate the mining sector, and the Department of Mineral Resources (DMR), which is under the Ministry, is responsible for the administration of exploration and production activities in accordance with geoscience and with the requirements of environmental protection. The

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<sup>1</sup> References that include a section mark (§) are found in the Internet References Cited section.

DMR also is responsible for supervising the coastal zone management program, petroleum development, mineral exploration, environmental protection in offshore areas, and the formulation of a viable program for the inspection of all petroleum and mining operations to ensure enforcement of applicable regulations. It conducts research on such environmental issues as mined land rehabilitation and the effect of offshore mining on coral reefs, mangroves, recreation areas, and shorelines. It also provides consulting services to the mining companies concerning technologies and equipment to be used to prevent environmental pollution (Dheeradilok, 1998).

## **Environmental Issues**

The adverse environmental impact of the proposed potash mining project in Udon Thani continued to be a major environmental issue in 2003. In March 2003, a six-member panel was named by the Ministry of Natural Resources and Environment (MNRE) to review the development plan for minimizing the adverse effects. According to one of the geologists, who led an expert panel to review the project's environmental impact assessment (EIA) report, the EIA failed to establish levels of operation to minimize the negative effects on nearby villagers. It also failed to alleviate the negative impacts of potash tailings, which would be made up mainly of salt, on village households and equipment. The panel completed its review and reported its findings to the MNRE in June 2003. In 2003, Asia Pacific Resources Ltd. submitted a revised EIA to the Government that included additional information on ways in which the company would monitor environmental impacts and the technology it would use to cope with the potash tailings; the company also submitted a request for a mining concession to the Ministry of Industry (Ecology Asia, 2003a§, b§).

## **Production**

Thailand's important minerals production in 2003 included barite, coal, dolomite, feldspar, natural gas, gemstones, gypsum, kaolin, limestone, crude petroleum, rock salt, silica, tin, tungsten, and zinc. The important processed mineral products were cement, fluorite (metallurgical grade), refined lead, refined petroleum products, steel, refined tin, and refined zinc. Thailand also produced tantalum metal powder and oxides, which were processed from such domestic and imported raw materials as tantalum-bearing scrap and tin slag.

In 2003, production of most industrial minerals except dolomite, marble, perlite, and pyrophyllite increased. Production of all metallic minerals except antimony and tungsten decreased considerably. In 2003, production of coal decreased; production of crude petroleum, natural gas condensate, and natural gas all increased considerably. Production of all processed minerals except refined tin increased because of the continued economic recovery (table 1).

## **Trade**

In 2003, exports rose to \$78.4 billion from \$66.1 billion in 2002 and imports also rose to \$74.2 billion from \$63.4 billion in 2002. Thailand's merchandise trade surplus increased to \$4.2 billion in 2003 from \$2.7 billion in 2002. As a result, the Thai baht appreciated against the U.S. dollar by 3.6% to 41.5 baht against US\$1.00 in 2003 compared with 43.0 baht in 2002. On the basis of two-way merchandise trade, Japan and the United States were the two major trade partners of Thailand in 2003 (Bank of Thailand, 2004a§, b§).

In the minerals trade, Thailand was a net importer of mineral commodities mainly because of its large import bills for coal, crude petroleum, iron and steel products, and nonferrous metals. According to Thailand's Custom Department, exports of major crude and intermediate mineral products totaled \$919 million in 2003, of which gypsum was valued at \$62 million; gold, \$54 million; refined tin, \$49 million; tantalum metal powder, \$36 million; zinc and zinc alloys, \$22 million; and all other mineral products, \$696 million. Exports of major processed mineral commodities were base-metal products (which included iron and steel), \$2.7 billion; precious stones and jewelry, \$1.9 billion; and refined petroleum products, \$1.5 billion (Bank of Thailand, 2004a§).

In 2003, imports of major mineral fuel commodities were as follows: coal, \$214.4 million; crude petroleum, \$7.1 billion; and refined petroleum products, \$1.6 billion. Imports of major nonfuel mineral products were as follows: iron and steel products, \$3.8 billion; other base metal products, \$2.0 billion; jewelry and silver bar, \$1.5 billion; and fertilizers, \$849 million (Bank of Thailand, 2004a§).

## **Structure of the Mineral Industry**

The structure of the mineral industry remained unchanged in 2003. Thailand's mineral industry consisted of a large mining and mineral-processing sector of industrial minerals and a small mining and mineral-processing sector of ferrous and nonferrous metals. The mining and quarrying industry employed about 47,000 workers in 2003. The energy sector, which included the production of coal, natural gas, and crude petroleum, was small but growing. Most nonfuel minerals mining and mineral-processing businesses were owned and operated by private companies incorporated in Thailand. Coal exploration and mining were operated principally by the state-owned Electricity Generating Authority of Thailand (EGAT) and several small local private coal mining companies. Oil and gas exploration and production were by the state-owned Petroleum Authority of Thailand (PTT) and several joint ventures of the PTT and foreign oil companies.

Commensurate with the Government's mineral policy to focus on the development of minerals for the domestic market, the production capacity of industrial minerals continued to increase in 2003. The cement industry, which had expanded by more than 40% of its capacity during the 1990s, had a production capacity of about 53.9 million metric tons per year (Mt/yr). The production capacity for exported minerals such as antimony, fluorite, and kaolin, however, had been shrinking during the past 5 years. Construction of Thailand's first copper smelter, which was halted in March 1998, resumed in 2003 and was scheduled to be completed by 2004. The country's production capacity of tantalum metal powder remained steady. This capacity, however, could be expanded if the worldwide demand for tantalum should rise again.

## Commodity Review

### Metals

**Copper.**—Progress of the Puthep copper development project had been hampered by the Government watershed zoning over the PUT 1 deposit, which required the approval of the Thai Cabinet for land access and mining leases before the company could proceed with a feasibility study within the area. In 2003, Pan Australian Resources N.L. (PAR) of Australia and its joint-venture partner Padaeng Industry Public Co. Ltd. (PDI) reportedly submitted a watershed appraisal report and applied for mining leases and for Cabinet approval for land access to conduct a feasibility study. The company also had shifted its focus to the PUT 2 deposit, where no watershed zoning issues were involved. The latest mineral resource estimates for the PUT 1 deposit were 84.5 million metric tons (Mt) at a grade of 0.44% copper, of which 22.1 Mt were indicated and 62.4 Mt, inferred; the mineral resource estimates for the PUT 2 deposit were 36.4 Mt at a grade of 0.42% copper, all of which were inferred (Pan Australian Resources N.L., 2003a§, b§).

Thai Copper Industries plc. (TCI), which suspended construction of its 165,000-metric-tons-per-year (t/yr) copper smelter and refinery in Rayong Province in eastern Thailand in March 1998, resumed construction of the smelter and refinery in 2003. In January 2003, the \$115 construction contract was awarded to Aker Kvaerner ASA of Norway to complete the project in 15 months. The copper smelter and refinery was scheduled to be commissioned by mid-2004. Kvaerner E&C (Thailand) Ltd. and Kvaerner U.S. Inc. were the Aker Kvaerner entities responsible for the project. To resume construction, TCI reportedly raised a \$174 million credit line from a consortium of local banks led by Krung Thai Bank and about \$79 million in new equity capital from Thai Film Industry and Aker Kvaerner, which provided a loan and new capital in exchange for a 30% equity interest in TCI (Metal Bulletin, 2003a; Aker Kvaerner, 2003§).

**Gold.**—Kingsgate Consolidated N.L. of Australia, through its 90% owned subsidiary Akara Mining Ltd., operated the Chatree gold mine, which is located about 280 kilometers (km) north of Bangkok and 45 km southeast of the provincial capital of Pichit on the border of Petchabun and Pichit Provinces. To save mining and haulage costs in its open pit operations and to provide business for local enterprises, the Chatree Mine negotiated a new 4-year mining contract with a local contractor in July 2003 (Kingsgate Consolidated Ltd., 2003c§).

According to Kingsgate Consolidated, for the financial year that ended on June 30, 2003, ore production totaled 1.5 Mt, of which 1.3 Mt of ore at a grade of 3.9 grams per metric ton (g/t) gold was treated; the gold recovery rate was 90.2%; and production of gold and silver was 4,805 kilograms (kg) and 15,059 kg, respectively, at a total cash cost of \$94 per ounce and total production cost of \$143 per ounce of gold. As a result, the Chatree Mine was rated as one of the world's lowest cost gold-mining operations. According to Thai DMR official statistics, the country's gold and silver production for calendar year 2003 was 4,269 kg and 12,496 kg, respectively (Kingsgate Consolidated Ltd., 2003a§).

In early 2003, the Kingsgate's board of directors approved an \$8.1 million budget for an expansion project of the Chatree Mine and processing plant. Construction work started in April 2003. The expansion project, which added a new high-ratio semi-autogenous grinding (SAG) mill and two carbon-in-leach tanks, doubled the capacity of the cyanide deoxygenation circuit, and converted the existing low-ratio SAG mill to a ball mill, was completed in December 2003. The expansion, which was completed under budget, raised the throughput of the mine by 50% to 1.8 Mt/yr (Kingsgate Consolidated Ltd., 2003a§; b§).

During 2003, Kingsgate Consolidated continued its exploration at Prospect A, which is located about 1 km north of the Chatree Mine. The drilling program at Prospect A, which was extended by 3,000 meters (m) to 14,000 m due to continuing positive results, was completed in April 2003. The company released its revised mineral resources estimate at Prospect A in May 2003. The first ore reserves (proved and probable) estimate for Prospect A, which was based on an infill drilling of about 12,000 m, was 7.4 Mt at a grade of 1.7 g/t gold and 18 g/t silver, which contained 402,400 ounces (12,520 kg) of gold and 4,320,000 ounces (134,400 kg) of silver. The reported ore reserves estimate was based on cut-off grades of 0.7 g/t gold for oxide ore and 0.8 g/t gold for primary ore using a gold price of \$330 per ounce (Society of Economic Geologists, 2003; Kingsgate Consolidated Ltd., 2003a§; MBendi Information Services (Pty) Ltd., 2003§).

In 2003, Thong Kam Co. reportedly was granted a gold mining license in the area of Loei Province. The gold project, however, had not been started by the end of 2003 (Department of Mineral Resources, 2003b§).

**Iron and Steel.**—Iron ore production dropped to 9,675 t from 570,110 t in 2002. Thailand continued to rely on imports of ferroalloys, pig iron, steel scrap, and crude steel (billet, slab and ingots) to meet the requirements for its rolling steel mill sector in 2003.

In 2003, Thailand's crude steel production increased by 41% to 3.6 Mt. According to the Southeast Asia Iron and Steel Institute (SEAISI), Thailand's production of hot-rolled (carbon) steel increased by 11% to 7.5 Mt, imports of iron and steel products decreased

by 1.8% to 9.9 Mt, and exports of iron and steel products increased by 15.7% to 1.9 Mt. Apparent consumption of total steel products increased by 10.2% to a record-high level of 11 Mt in 2003 (Southeast Asia Iron and Steel Institute, 2004a§).

Thai steel consumption was projected to grow by 6% to 7% in 2004 and 2005. The Iron and Steel Institute of Thailand expected that the rising costs of raw materials would pose major problems for the domestic steelmakers in terms of their competitiveness against imports, even though the domestic demand for their product from the construction, automobile, and household goods sectors would remain strong (Metal Bulletin Monthly, 2003).

In May 2003, the Thai Government, through the Ministry of Commerce, decided to impose antidumping duties ranging from 5.98% to 136.5% on hot-rolled steel imported from Japan and 13 other countries, which included Algeria, Argentina, India, Indonesia, Kazakhstan, the Republic of Korea, Romania, Russia, Slovakia, South Africa, Taiwan, Ukraine, and Venezuela. A 36.25% tariff was imposed on imports from Japan. The Government would consider exempting antidumping duties on hot-rolled steel imports from Japan, however, if the local steel industry could not produce Japan's high-standards hot-rolled steel (Southeast Asia Iron and Steel Institute, 2003b§).

In December 2003, the Thai Government announced that import taxes would be gradually reduced to 5% on certain items. The previous 10% import taxes imposed on various hot-rolled steel products would be reduced to 7.5% for the period between December 16, 2003, and December 31, 2004, then reduced further to 5% beginning on January 1, 2005. The previous 12% import taxes imposed on cold-rolled steel sheet in coils and cold drawn bar would be reduced to 9.5% for the period between December 16, 2003, and December 31, 2004; to 7% for the entire 2005 calendar year; to 6% for the entire 2006 calendar year; and to 5% beginning in January 2007. The previous 15% import taxes imposed on coated steel products would be reduced to 12% for the period between December 16, 2003, and December 31, 2004; to 9% for the entire 2005 calendar year; to 7% for the entire 2006 calendar year; and to 5% beginning in January 2007 (Southeast Asia Iron and Steel Institute, 2004b§).

In June 2003, Nakornthai Strip Mill Plc (NSM) announced that it would merge with Siam Integrated Cold Steel (SICOS). NSM planned to raise \$85 million through a public share offering—\$65 million would be used to fund the facilities for the production of hot-rolled steel and \$20 million would be used as working capital. After the merger, NSM would have a production capacity of 1.5 Mt/yr of hot-rolled steel and 500,000 t/yr of cold-rolled steel (Southeast Asia Iron and Steel Institute, 2003a§).

**Lead.**—Lead mining from the Song Toh area in Kanchanaburi Province had stopped since 2000 because of lead contamination in Klity Creek in the Thung Yai Naresuan Wildlife Sanctuary. According to the Thai DMR, only small amounts of lead had been produced from Tak Province between 2001 and 2002 and there was no lead mine production in 2003. To resume lead mining, the Ministry of Industry reportedly was planning to ask the Thai Cabinet to set aside a 77-km<sup>2</sup> area of prime forest land from a proposed 600-km<sup>2</sup> area of the Lam Klong Ngu National Park, adjacent to a World Heritage site of the Thung Yai Naresuan Wildlife Sanctuary in Kanchanaburi Province. According to the Department of Basic (Primary) Industries and Mines, the area was estimated to contain about 7.73 Mt of lead reserves. The Forestry Department had previously delayed or rejected requests for mining permits in that area. The Bo Ngam Group that operated a lead mine in the area for over two decades had stopped mining after 1995 and lead mining operations by Kanchanaburi Exploration and Mining Co. Ltd. in the area had also been idled since December 2002 (Ecology Asia, 2003c§).

**Tungsten.**—Mine production of tungsten increased sharply in 2003 owing to the opening of a new mine, which is located near the small town of Ban Pin, about a 2-hour drive southwest of Chiang Mai in northern Thailand. In 2001, the Government awarded mining and export licenses to SC Mining Co. Ltd. for the production of high-grade ferberite (an iron tungsten mineral) concentrate for export. SC Mining, which used modern mining equipment and mineral-processing technology, was fully funded and 100% owned by the Som Chai family (Black, 2003).

**Zinc.**—Mine production of zinc ore was solely by PDI at the Padaeng Mine, which is located 12 km southeast of Mae Sot in Tak Province. Zinc silicate ore production from the mine increased by 32.6% to 249,539 t in 2003. The average metal content of zinc silicate ore produced in 2003 was about 25% zinc. All zinc ore and concentrates, which included imports, were delivered to the zinc smelting and refining facilities in Tak Province for the production of zinc metal. As of December 31, 2003, total mineral resources of the Padaeng Mine were estimated to be 4,595,000 t, of which 4,102,000 t were exploitable resources at a grade of 12.3% zinc (Padaeng Industry Public Co. Ltd., 2004§).

PDI's zinc smelter in Tak, which is located 96 km from the Padaeng Mine, consumed 306,549 t of ore and concentrate in 2003, of which 149,539 t was domestic ore and 157,010 t was imported ore mainly from Australia, Peru, and neighboring countries in Southeast Asia. In 2003, overall zinc production increased by 8.1% to 113,686 t, of which 69,600 t was zinc slab (ingot) and 44,086 t was zinc alloy (Padaeng Industry Public Co. Ltd., 2004§).

In 2003, imports of zinc ore totaled 151,623 t and were valued at \$39.44 million. Exports of zinc ingot and alloy increased by 17.8% to 24,119 t compared with 20,467 t in 2002, and were valued at \$21.75 million (Department of Mineral Resources, 2003a§).

## **Industrial Minerals**

**Barite.**—Production of barite decreased by 16% to 115,600 t compared with 137,469 t in 2002 owing mainly to a halt in production of drilling mud-grade barite powder in 2003. Asian Mineral Resources and Pands Group Mining & Milling Co., through its subsidiary P & S Barite Mining Co. Ltd., operated mines and beneficiation plants in the Provinces of Loei and Mae Hong Son in northern Thailand and in the Provinces of Nakhon Si Thammarat and Satun in southern Thailand. Additionally, there were 5 to 6 other small-scale barite mining companies that operated in the Provinces of Loei, Mae Hong Son, Nakhon Si Thammarat, and Udon Thani.

Of the barite produced in 2003, 4.6% was chemical grade and 95.4% was not ground. In 2003, Thailand exported 28,289 t of barite, of which 9% was chemical grade; 29%, drilling mud-grade; and 62%, not ground. Imports of barite increased by 50.9% to 28,379 t in 2003 compared with 18,808 t in 2002 (Department of Mineral Resources, 2003a§).

**Cement.**—Thailand's clinker output decreased by 11.4% to 33.6 Mt in 2003 following a 13% increase in 2002 and a 14.2% increase in 2001. Cement production, however, increased by 2.7% to 32.5 Mt in 2003 following a 13.5% increase in 2002 because of the continued growth in domestic demand for cement for residential housing construction in 2003. This growth resulted largely from Government policies to stimulate housing demand, which included lower interest rates, tax reductions on house purchases, and the development of housing projects for low-income families. The overall growth in the construction sector, however, was much slower in 2003 than in 2002 because of a slowdown in construction activities in the commercial sector and infrastructure projects in 2003.

According to the Thailand Fellowship of Cement Manufacturers, the cement industry's production capacity was 54 Mt/yr in 2003. Domestic demand increased by 4% to 23 Mt in 2003. Thai demand for cement was expected to grow at a rate of 7% in 2004, with private consumption as the main driver, and the cement price was expected to increase in 2004. Exports of cement totaled 13.8 Mt in 2003 (Bangkok Post, 2004§).

In 2003, Siam Cement Industry Co. Ltd., which was the country's leading cement producer, operated at 67% of its capacity of 23.2 Mt/yr and had 38% of the market share. Siam City Cement Public Co. Ltd., which was the country's second leading cement producer, operated at 68% of its capacity of 14.5 Mt/yr and had 27% of the market share. TPI Polene Co. Ltd. (TPIPL), which was the third leading cement producer, operated at 62% of its capacity of 9 Mt/yr and had 18% of market share. Asia Cement Public Co. Ltd., which signed a service agreement with Jalaprathan Cement Public Co. Ltd. (both companies were controlled by Italcementi Group of Italy), operated at 73% of their combined capacity of 7.1 Mt/yr and had a combined market share of 13% (Thailand Fellowship of Cement Manufacturers, 2003).

**Potash.**—Asia Pacific Resources Ltd. (APR) announced in May 2003 that it had submitted an application for four mining leases for the mining area that covers the potash deposits in Udon Thani South in northeastern Thailand, in compliance with the terms of the concession agreement between the company and the Government. The Udon Thani South deposit's potash resources were estimated to be 302 Mt at a grade of 23.5% K<sub>2</sub>O, of which 30 Mt at 26.8% K<sub>2</sub>O was within a high-value core area that averaged 7.2 meters in thickness (Asia Pacific Resources Ltd., 2003c§).

In November 2003, APR announced that its subsidiary Asia Pacific Potash Corp. (APPC) had signed a memorandum of understanding (MOU) with Beijing-based China State-Owned Enterprise Investment Company (CSEIC). According to the MOU, the two companies would work together to develop APPC's Udon Thani potash deposit in northeastern Thailand, would combine their efforts in particular to secure long-term off-take commitments for the supply of potash to the agricultural markets in China, Thailand, and other Asian countries, and would arrange financing of about \$300 million, which is the estimated capital cost for the first stage of the proposed 2 Mt/yr Udon South Mine. APR reportedly was still in discussions with other potential investors and strategic partners who could bring value to the project (Asia Pacific Resources Ltd., 2003b§).

In November 2003, APPC filed the application for the extended special prospecting licenses to facilitate the extension of the expiring special prospecting licenses held by the company over the Udon North potash deposits, where the potash resources were estimated to be 665 Mt at a grade of 16% to 17% K<sub>2</sub>O (Fertilizer Week, 2003; Asia Pacific Resources Ltd., 2003a§).

## **Mineral Fuels**

**Coal.**—Coal (lignite) production decreased by 3.8% to 18.8 Mt in 2003. EGAT, which operated the Mae Moh, Sop Prap, and Muang mines in the Provinces of Lampang and Krabi, produced about 16 Mt; the remaining 2.8 Mt was produced by Banpu Public Co. Ltd. and Lana Lignite Public Co. Ltd, which operated mines in the Province of Lampang, and several other coal mining companies that operated in the Provinces of Lampang, Lamphum, Phayao, and Phetchaburi. To meet the overall coal demand, Thailand imported 7.1 Mt of coal, which was valued at \$255.8 million in 2003. Of that total, 6.51 Mt was bituminous, which was an increase of 32% compared with the 4.94 Mt imported in 2002; 532,860 t was anthracite; and 64,750 t was coking coal, which was a decrease of 8.3% compared with the 70,650 t imported in 2002 (Energy Policy and Planning Office, 2004a§).

In 2003, EGAT conducted additional coal surveys and exploration in Wiang Haeng District, Chiang Mai Province and in Saba Toi District, Songkhla Province. For the northern Wiang Haeng basin in Chiang Mai, EGAT was permitted to develop the coal basin without a bidding process, provided that the project's EIA was approved by the Government. Chiang Mai University was appointed to conduct the EIA for the project, which was scheduled to start in 2004; the EIA would include a public participation component to allow the local community to participate in the environmental impact study. Additionally, EGAT also was granted a permit to develop the Saba Yoi coal basin in Songkhla Province. Community development and public communication programs had been carried out continuously in 2003 (Electricity Generation Authority of Thailand, 2003).

In May 2003, more than 1,000 villagers from Wiang Haeng District, Chiang Mai Province, reportedly submitted a petition to the Ministry of Natural Resources and Environment to protest plans to build a coal (lignite) mine in the area. The project site was a watershed area of the Mae Taeng River that provided tap water to the Chiang Mai provincial capital about 70 km away; in addition, some farmers relied on the Mae Taeng River to grow garlic, which was the main crop in the area (Ecology Asia, 2003d§).

Demand for domestically produced lignite totaled 17.9 Mt in 2003, of which 15.4 Mt was consumed by EGAT in power generation at the 2,625-megawatt Mae Moh lignite-fired powerplant and 2.5 Mt was consumed as energy by the manufacturers of cement, paper, fiber, and lime; tobacco curers; and other users. Demand for imported coal (mostly anthracite, bituminous, and coking coal), which

totaled 7.1 Mt, was consumed mainly by the manufacturers of cement and ferrous and nonferrous metals and by other end users (Energy Policy and Planning Office, 2004a§).

**Natural Gas and Petroleum.**—Thailand's natural gas production increased by 6% to an average of 59.6 million cubic meters per day in 2003 from an average of 56.2 million cubic meters per day in 2002 owing mainly to a 36% increase in output from the Pailin Gasfield. In 2003, natural gas was produced from 19 gasfields, most of which were located offshore. About 54% of Thailand's natural gas was produced by Unocal Thailand Ltd. (UT) from 10 offshore gasfields and condensate fields (Baanpot, Erawan, Funan, Gomin, Jakarawan, Pailin, Platong, Satun, South Satun, and Trat); the remaining 46% was produced by PTT Exploration and Production (PTTEP) (the upstream subsidiary of PTT), ChevronTexaco Corp., and other companies, from seven offshore gasfields (Benjamas, Bong Kot, Plamuk, Plandaeng, Surat Thani, Tantawan, and Yala) and two onshore gasfields (Nam Phong and Sirikit) (Energy Policy and Planning Office, 2004c§).

UT, which was Thailand's leading gas producer, operated 100 platforms in the central Gulf of Thailand. UT supplied 75% of its natural gas output to meet 33% of Thailand's power-generation requirements and 25% to meet fuel requirements for the manufacturing, and transportation industries, for household cooking, and as feedstock for petrochemicals. In 2003, UT signed an agreement with the national oil company Petroleum Authority of Thailand Plc (PTT) to amend and extend two of UT's gas sales contracts; the company would increase sales volume from 20.95 million cubic meters per day in 2003 to 24.07 million cubic meters per day in 2006 and to 35.11 million cubic meters per day in subsequent years. To supply the increased gas sales to PTT, UT and its partners planned to spend about \$4 billion on exploration and production at three gasfields in the Gulf of Thailand during the next 10 years. UT and its partners reportedly were to spend \$300 million on natural gas development in the Gulf of Thailand in 2003 (Petroleum Economist, 2003b, c; ASEAN Center for Energy, 2003c§, d§).

The state-owned PTTEP announced that it would spend a total of \$2.14 billion for its capital and operation expenditures during the next 5 years. About 38% of the total would be for developments in its existing Bongkot and Pailin Gasfields in the Gulf of Thailand and the Yadana and Yeagun gasfields offshore Burma (Myanmar); about 40% of the total would be for future development of the Arthit Gasfield and B17 in the Thailand-Malaysia joint development area. In 2003, PTTEP and its partners also signed an amendment to the Pailin gas sales agreement with PTT to reduce the Pailin gas price by 3% and increase the daily contractual quantity by 7% to about 10 million cubic meters per day, effective October 1, 2003 (Petroleum Economist, 2003a; ASEAN Center for Energy, 2003b§).

Production of crude petroleum increased by 27.5% to an average of 96,322 barrels per day (bbl/d), and that of condensate, by 16.6% to an average of 62,663 bbl/d in 2003. The 2003 increase in crude petroleum output was the result of increased production from the Benjamas and Plamuk Oilfields. In 2003, crude petroleum was produced from 10 oilfields. The Benjamas, which was the largest offshore oilfield, was operated by Chevron Offshore (Thailand) Ltd. and produced 51.2% of the country's total; the Sirikit, which was Thailand's largest onshore oilfield, was operated by Thai Shell Exploration and Production Co. Ltd. and produced 19.9%; the Plamuk, which was Thailand's second largest offshore oilfield, was operated by UT and produced 21.0%; and the Tantawan, which was Thailand's third largest offshore oilfield, was operated by Chevron Offshore (Thailand) and produced 5.4% in 2003. In November 2003, Chevron Offshore (Thailand) Ltd. reportedly discovered oil and gas in two exploration wells in block 9A in the Gulf of Thailand. The company applied for a production area license for the two wells—Tantawan 23 and Tantawan 24. The remaining 2.5% was produced from six smaller oilfields. In 2003, about 27.1% of condensate was produced from the Pailin Gasfield; 25.1%, from the Bongkot Gasfield; and 19.3%, from the Erawan Gasfield (ASEAN Center for Energy, 2003a§; Energy Policy and Planning Office, 2004b§, c§).

To meet its overall demand for crude petroleum, Thailand imported 775,870 bbl/d of crude petroleum, which accounted for about 89% of the total crude petroleum supply of 872,192 bbl/d in 2003. Thailand's refinery intake totaled 846,091 bbl/d in 2003 compared with 827,688 bbl/d in 2002. Thailand's total refining capacity was 703,100 bbl/d of crude petroleum. Shell Co. of Thailand Ltd. had a 275,000-bbl/d-crude-capacity refinery in Map Ta Phut, Rayong Province; Thai Oil Co. Ltd. had a 192,850-bbl/d-crude-capacity refinery in Sriracha, Chonburi Province; Esso Standard Thailand Ltd. had a 173,500-bbl/d-crude-capacity refinery in Sriracha, Chonburi Province; and PTT Plc had a 61,750-bbl/d-crude-capacity refinery in Bang Chak, Bangkok (Oil & Gas Journal, 2002).

## Outlook

During the next 4 to 5 years, the Thai mining sector is expected to expand and contribute more to the country's GDP because of the likely development of the Puthep copper mine in Loei Province, the Somboon potash mine in Udon Thani Province, and the Wiang Haeng coal (lignite) mine in Chiang Mai Province and the development and expansion of new and existing offshore gasfields in the Gulf of Thailand. During the next 2 years, the mineral industry of Thailand is expected to continue to be dominated by the production of coal, gold, gypsum, and limestone. Thailand is expected to become one of the refined copper producers in the Asia and the Pacific region by the end of 2004.

Thailand's economy is forecasted to grow at a faster pace in the next 2 years than it did in 2002 and 2003. The International Monetary Fund projects that the Thailand's GDP will grow at a rate of 7.0% in 2004 and 6.7% in 2005 (International Monetary Fund, 2004§).

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## **Major Publications**

### **Department of Mineral Resources:**

Mineral Statistics of Thailand, annual.

Metal Statistics of Thailand, annual.

### **Bank of Thailand:**

Annual report, annual.

Economic report, annual.

Economic condition and economic data.



TABLE 1  
THAILAND: PRODUCTION OF MINERAL COMMODITIES <sup>1</sup>

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003
<b>METALS</b>					
Antimony:					
Ore:					
Gross weight	130	178	40	3	83
Sb content	59	84	18	1	38
Metal, smelter	40	16	12	--	--
Gold kilograms	--	--	320	4,950	4,269
Iron and steel:					
Iron ore:					
Gross weight	122,633	100	50	570,110	9,675
Fe content <sup>c</sup>	61,000	50	25	285,000	4,800
Crude steel thousand tons	1,532	2,100	2,127	2,538 <sup>r</sup>	3,572
Lead:					
Ore:					
Gross weight	23,783	24,760	800	6,500	--
Pb content	11,900	15,600	500	3,200	--
Metal, refined:					
Primary	3,025	3,390	3,500	2,000 <sup>r</sup>	2,000
Secondary	23,741	23,803	23,000 <sup>r</sup>	28,000 <sup>r</sup>	28,000
Total	26,766	27,193	26,500 <sup>r</sup>	30,000 <sup>r</sup>	30,000
Manganese ore:					
Battery- and chemical-grade, 75% MnO <sub>2</sub>	46	225	45	--	--
Metallurgical-grade, 46% to 50% MnO <sub>2</sub>	675	--	--	--	--
Total, gross weight	721	225	45	--	--
Total Mn content <sup>c</sup>	360	110	23	--	--
Silver kilograms	--	--	1,159	18,018	12,496
Tantalum, metal and oxide powder	98	210	150	200	150
Tin:					
Concentrate:					
Gross weight	3,400	2,363	2,383	1,384	980
Sn content	2,712	1,930	1,950	1,130	793
Metal, smelter, primary	17,306	17,076	22,387	17,548	15,763
Tungsten concentrate:					
Gross weight	54	54	92	53	390
W content <sup>c</sup>	30	30	50 <sup>r</sup>	31 <sup>r</sup>	208
Zinc:					
Ore:					
Gross weight	185,752	159,093	88,664	151,876 <sup>r</sup>	148,297
Zn content <sup>c</sup>	24,000	27,000	15,300	33,600	37,100
Metal, primary	75,639	77,525	74,129	72,502	69,600
Alloy, Zn content	21,653	23,617	30,668	32,646	44,086
Zirconium concentrate, gross weight	--	100	--	--	--
<b>INDUSTRIAL MINERALS</b>					
Barite	76,092	56,180	23,559	137,469	115,600
Cement, hydraulic thousand tons	25,354	25,499	27,913	31,679	32,530
Clays:					
Ball clay	317,877	394,154	341,272	450,818	579,404
Kaolin, marketable:					
Beneficiated, washed	113,005	201,226	168,063	127,132	184,562
Nonbeneficiated, unwashed	243,213	286,912	125,133	168,883	373,811
Filler	14,765	19,836	13,520	3,150	950
Diatomite	2,332	390	720	780	1,288
Feldspar	626,415	542,991	710,543	783,733	824,990
Fluorspar, crude, metallurgical-grade	13,005	4,745	3,020	2,270	2,368
Gemstones thousand carats	1,267	928	1,071	1,597	716
Gypsum thousand tons	5,005	5,830	6,191	6,326	7,291
Mica	78	107	72	--	--
Perlite	5,800	6,000	9,915	7,600	5,700
Phosphate rock, crude	3,880	3,260	2,359	3,680	13,870

See footnotes at end of table.

TABLE 1--Continued  
THAILAND: PRODUCTION OF MINERAL COMMODITIES <sup>1</sup>

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003
INDUSTRIAL MINERALS--Continued					
Salt:					
Rock	739,502	792,250	852,565	908,968	892,243
Other <sup>c</sup>	100,000	100,000	100,000	100,000	100,000
Sand, silica, glass	531,588	471,547	513,880	781,014	1,293,929
Stone:					
Calcite	72,130	87,100	159,050	172,760	232,025
Dolomite	485,393	625,127	871,308	933,209	865,708
Granite:					
Dimension stone                      cubic meters	6,190	7,595	6,659	7,597	9,866
Industrial rock                      thousand tons	2,139	2,154	2,546	3,370	3,107
Limestone:					
For cement manufacture only                      do.	48,306	43,492	46,984	54,214 <sup>r</sup>	46,362
Construction and other uses                      do.	35,853	37,017	40,100 <sup>r</sup>	56,226 <sup>r</sup>	66,073
Marble, dimension stone and fragment                      cubic meters	294,337	270,036	314,445	461,272	339,166
Marl for cement manufacture only	32,044	7,290	7,755	83,135	80,405
Quartz	3,760	5,177	48,908	32,954	65,559
Shale for cement manufacture only                      thousand tons	3,223	3,110	3,364	5,017	3,488
Talc and related materials:					
Pyrophyllite	38,053	46,011	59,602	103,496	73,556
Talc	4,960	7,390	6,838	1,702	8,501
MINERAL FUELS AND RELATED MATERIALS					
Coal, lignite                      thousand tons	18,261 <sup>r</sup>	17,786 <sup>r</sup>	19,607 <sup>r</sup>	19,572 <sup>r</sup>	18,830
Natural gas, gross production                      million cubic meters	19,307	20,190	19,637	20,527 <sup>r</sup>	21,767
Petroleum:					
Crude                      thousand 42-gallon barrels	12,412	21,147 <sup>r</sup>	22,599 <sup>r</sup>	27,582 <sup>r</sup>	35,158
Natural gas condensate                      do.	18,115	19,060 <sup>r</sup>	18,924 <sup>r</sup>	19,609	22,872
Refinery products:					
Liquefied petroleum gas                      do.	28,853	32,511	37,067	37,069	38,872
Gasoline                      do.	54,290	50,862	52,376	51,896	54,342
Jet fuel                      do.	25,908	27,347	26,651	29,373	26,778
Kerosene                      do.	2,181	3,090	3,693	3,457	4,386
Distillate fuel oil                      do.	49,242	43,970	40,669	37,610	38,248
Residual fuel oil <sup>c</sup> do.	22,000	22,000	22,000	22,000	23,000
Unspecified <sup>c, 2</sup> do.	3,500	3,500	3,500	3,500	3,500
Total <sup>3</sup> do.	186,000	183,000	186,000	185,000	189,000

<sup>c</sup>Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>Includes data available through September 3, 2004.

<sup>2</sup>Includes refinery fuel and refinery gains or losses.

<sup>3</sup>Data are rounded to three significant digits; may not add to total shown.

Sources: Department of Mineral Resources, Mineral Statistics of Thailand, 1998-2003 and Metal Statistical Yearbook, 2003; Ministry of Commerce, Energy Policy and Planning Office, Energy Data Notebook, 1989-2003, 15-year Series Report.

TABLE 2  
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2003

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Barite		Asian Mineral Resources Co. Ltd.	Loei, Mae Hong Son, Nakhon Si Thammarat, and Satun Provinces	60
		P & S Barite Mining Co. Ltd.	Loei and Nakhon Si Thammarat Province	60
Cement		Asia Cement Co. Ltd.	Pra Phutthabath, Saraburi Province	4,800
Do.		Jalaprathan Cement Co. Ltd. (Cement Francais S.A., 37%; Veatprapat Holding Co. Ltd., 19%; others, 44%)	Takli, Nakhorn, Sawarn Province; and Cha-Am, Petchburi Province	2,350
Do.		Samukee Cement Ltd.	Pakchong, Nakhon Ratchasima Province	125
Do.		Saraburi Cement Co. Ltd. (CEMEX Asia Holdings Ltd. of Mexico, 99%)	Chalerm Phrakiat, Saraburi Province	700
Do.		Siam Cement Industry Co. Ltd. (Bureau of the Crown Property, 30%; Thai Security Depository Co. Ltd., 6.94%; CPB Equity Co. Ltd., 5.6%; other financial Institutions and general public, 57.46%)	Kaeng Khoi, Phabudhabat, and Khao Wong, Saraburi Province; Chae hom, Lampang Province; Thung Song, Thammarat Province; and Ta Luang, Ayutthaya Province	23,200
Do.		Siam City Cement Co. Ltd. (Holcim Ltd. of of Switzerland, 33.7%; Rattanak family, 27%; other investors, 39.3%)	Kaeng Khoi, Saraburi Province	14,500
Do.		TPI Polene Co. Ltd.	Kaeng Khoi, Saraburi Province	9,000
Coal, lignite		Electricity Generating Authority of Thailand	Mae Moh, Lampang Province; Li, and Lamphun Province	20,000
Do.		Lanna Resources Public Co. Ltd.	Baan Pa Kha, Lampang Province; and Nong Ya Plong, Petchburi Province	1,800
Fluorspar, concentrate		Asian Mineral Resources Co. Ltd.	Mae Hong Son Province	14
Gas, natural	million cubic meters per day	Esso Exploration and Production Khorat Inc.	Namphong, Khon Kaen Province	4
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot in the Gulf of Thailand	15
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Kaphong, Pladang, Satun, Paili, Trat, all in the Gulf of Thailand	33
Gold	kilograms	Akara Mining Ltd. (Kingsgate Consolidated N.L. of Australia, 100% )	Chatree, Pichit Province	5,000
Gypsum		Thai Gysum Products Pcl. (Thaigips Holdings Ltd., 40.75%; BPB Gypsum B.V., 30%; others, 29.25%)	Nong Bau, Nakhon Sawan Province and Ban Munnak, Phichit Province	2,000
Do.		Vanich Gypsum Co. Ltd.	Khlong Prab, Mai Rieng. Thoong Yai Mai in Provinces of Nakhon Si Thammarat and Surat Thani	2,000
Lead, in concentrate		Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, Nong Phai, and Bo Ngam in Kanchanaburi Province	30
Petroleum, crude included condensate	thousand 42-gallon barrels per day	Chevron Offshore (Thailand) Ltd.	Benjamas, Tantanwan, offshore in the Gulf of Thailand	35
Do.	do.	Tah Shell Exploration and Production Co. Ltd.	Sirikit in Kamphaenghet Province	24
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot, offshore in the Gulf of Thailand	12
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Gomin, Jakrawan, Kaphong, Pailin, Platon, Satun, Surat, Trat Plamuk, offshore in the Gulf of Thailand	38
Steel, rolled		The Bangkok Iron and Steel Works Co. Ltd.	Phrapradaeng, Samutprakarn Province	120
Do.		Bangkok Steel Industry Public Co. Ltd.	do.	300
Do.		Millenium Steel Co. Lt. (Siam Cement Public Co. Ltd., 45%; NTS creditors, 44.65%; McDonald Investment, 6.58%; NTS shareholders, 3.77%)	Provinces of Chon Buri, Muang Rayong, and Saraburi	1,700
Do.		Namheng Steel Co. Ltd.	Lopburi Province	350
Do.		Sahaviriya Group Corp. Ltd.	Bang Saphan, Prachuap Khiri Khan Province	2,400
Do.		Siam United Steel Co. Ltd.	Rayong Province	1,000
Do.		Siam Yamato Steel Co. Ltd.	Muang, Rayong Province	600
Tantalum, metal powder and oxides	metric tons	H.C. Starck (Thailand) Co. Ltd. (H.C. Starck GmbH, 94.98%; others, 5.02% )	Map Ta Phut, Rayong Province	250

TABLE 2--Continued  
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
<u>Tin:</u>			
Concentrate	Numerous small companies	Nakhon Si Thammarat, Phangnga, Phuket, and Ranong Provinces	3
Refined	Thailand Smelting and Refining Co. Ltd. (Amalgamated Metal Corp., 75.25%; other, 24.75%)	Phuket, Phuket Province	30
<u>Zinc:</u>			
In concentrate	Padaeng Industry Public Co. Ltd. (Umicore SA of Belgium, 44.77%; Ministry of Finance, 13.81%; others, 41.42%)	Mae Sot, Tak Province	30
Refined	do.	Tak, Tak Province	105